S-101 Value Added Roadmap

1 Introduction

S-101 is a new Product Specification for the Electronic Navigational Chart. It is currently under development by the IHO Transfer Standards and Maintenance Applications Development Working Group (TSMAD). S-101 ENCs will remain, fundamentally, the basic navigation tool for ECDIS and therefore most of the features of the S-57 ENC are retained. However, using the experience and stakeholder feedback gained over a number of years many new concepts and constructs have been developed, aimed at improving the efficiency of the data and improving the user experience. Many of the changes may appear obscure or innocuous, but taken as a whole they will ensure that S-101 is, to a large extent future-proofed, unlike S-57 which is becoming ever more unmanageable.

The intention of this paper is to provide an estimated timescale of events (Figure 1) in the development of S-101 and to support this with a more detailed account of the various processes and impacts which are anticipated to have an effect on the various stakeholders. The timescales involved are very much dependant on available resources.

Section 2 provides a detailed account of all the processes involved in the development of S-101, its environment and transmission from S-57 ENCs.

Section 3 provides details of the content of S-101 and its impact on production of ENCs and the end user in particular.

Section 4 provides a general discussion about the implications and impacts for other stakeholders who are involved with ECDIS, type approval, data validation etc. and other standards such as S-52, S-58 and S-64 which are essential to the overall process.

Without question, one of the key enablers to the introduction of S-101 is the identification and implementation of any changes required to the IMO Performance Standard. This may be simply adding S-101 to the list of standards, however the process for change must be initiated ASAP.

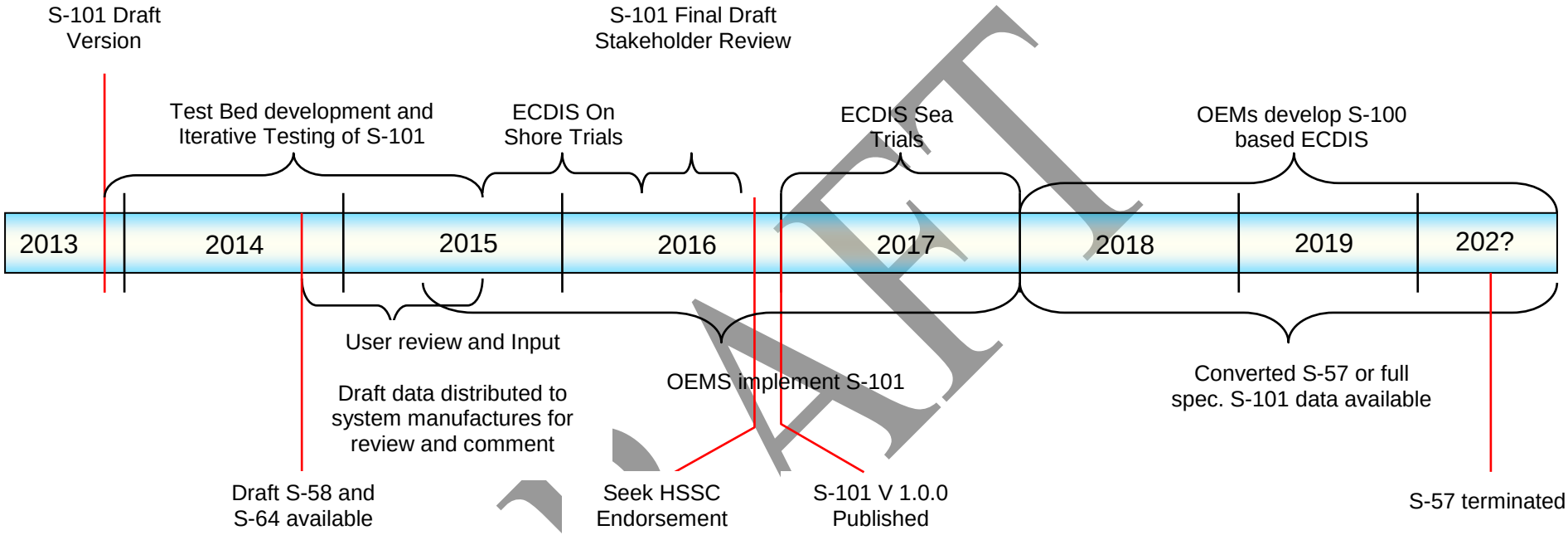


Figure 1 – Projected Timescale for S-101 Implementation

2 S-101 Roadmap

2.1 S_101 First Draft (October 2013)

This version will be the basis for an extensive testing programme. As described in section 3 there are many new concepts which need to be proved and S-101 will undoubtedly change throughout this period before a stable version can be published for stakeholder evaluation. This version will contain all the various catalogues required for testing; feature, portrayal, alerts / indications and agency codes.

2.2 Initial Test Bed (2013 - 2015)

The first test bed will be a relatively simple viewer which is capable of importing and portraying data. It will facilitate the ability to import new feature and portrayal catalogues and provide functionality to change the display based on some of the parameters which users can change which affect the display. For example the safety contour and depths, day / night environments etc.
It is anticipated that this phase of testing will be completed by the third quarter of 2015, but only if all the elements are stable and user evaluation and satisfaction has been achieved.
It is important to understand that this test bed will be S-100 based, capable of testing other product specifications which can be either supplementary to S-101 ENCs or another type of GIS application.

2.2.1 Converter

The S-57 to S-101 converter will play an important part in the testing phase to validate its capability during the transition to a full specification S-101. Full specification S-101 datasets will be created by manipulating converted S-57 data..

2.3 S-58 and S-64 (2014)

New versions of both of these standards will be developed for S-101, but there is still a need for discussion about how they will be configured. It is conceivable that each could be split into two parts, part 1 for S-57 and part 2 for S-101. Alternatively both could be annexes of S-101 with the possibility that new annexes could be published independently without a change to the main S-101 version number as is currently the case with the S-57 Use of the Object Catalogue. Currently ENCs can be produced and distributed without any proof that they have been validated. A method is being investigated whereby datasets will be certified as being valid to a certain level. This will probably be based on similar methods currently used in the S-63 standard.
S-64 will form the basis of a new version of IEC 61174.

2.4 OEM Review (2014 - 2015)

Many stakeholders acting as expert contributors have been involved in the development of S-101, however once a relatively stable version of S-101 has been established during the testing phase this will be distributed to the various manufacturers involved in all processes creating, delivering and using the data. Draft S-101 versions of S-58 and S-64 will be made available during this period. Results of this review will be fed back into the main testing process and new iterations of S-101 developed. Also during this period consideration will be given to the development of performance standards and in particular IEC61174.

2.5 **OEM Implementation** (2015 - 2017)

It is intended that once a relatively stable version of S-101 is published ECDIS OEMs, production software and validation tool manufacturers will start to develop their systems in order to contribute to the trials which follow.
This will also be an opportunity for data producers to help test new software and become familiar with the new content and structure of S-101 as described in section 3. Any data produced can be utilised in the trials described in 2.5 and 2.7.

2.6 **ECDIS On Shore Trials** (2015 - 2016)

It is anticipated that at least one and possibly more S-100 enabled ECDIS will be available for the trials. All aspects of the process will be tested extensively including - data production, validation and distribution; ECDIS type approval and functionality, extensive user involvement, particularly training establishments. A dual fuel regime will test the capabilities and any issues with distributing both S-57 and S-101 ENC datasets.

2.7 **S-101 Final Draft** (2016)

During the second half of 2016 a thorough stakeholder review will culminate in a paper to the HSSC seeking endorsement of version 1.0.0 and a recommendation to seek M.S. approval to publish.
This version will contain a caveat stating that S-101 is still not available for across the board implementation and will be only used for testing until an announcement is made about a final release date through the IHB.

2.8 **ECDIS Sea Trials** (2017)

This will be a similar process to the on shore trials, but will emulate a real time environment.

2.9 **S-101 Released for full implementation** (2018)

At this point S-101 will be launched for full use. Those OEMs who have not developed

3 S-101 – New Content

S-101 will continue to be the basic electronic navigation chart for use as official data in ECDIS. However it provides an opportunity to draw upon the experience gained through the use of S-57 in order to improve the content and functionality of the data. TSMAD have hosted two S-101 Stakeholder Workshops attended by a variety of interested parties covering the whole domain of electronic navigation. Many of the new concepts which are being introduced have either evolved through, or improved by the discussions held during the workshops. The following items are as included in the first draft of S-101, but may be subject to change and or refinement during the testing phase. For a more detailed account of the following please refer to the latest Draft of S-101.

3.1 Features and Attributes

The main differences between the S-57 ENC feature and attribute catalogues and the S-101 feature catalogue are as follows:

- Feature catalogues are now unique to the individual product specifications. Currently the S-57 catalogues are designed as one fits all.

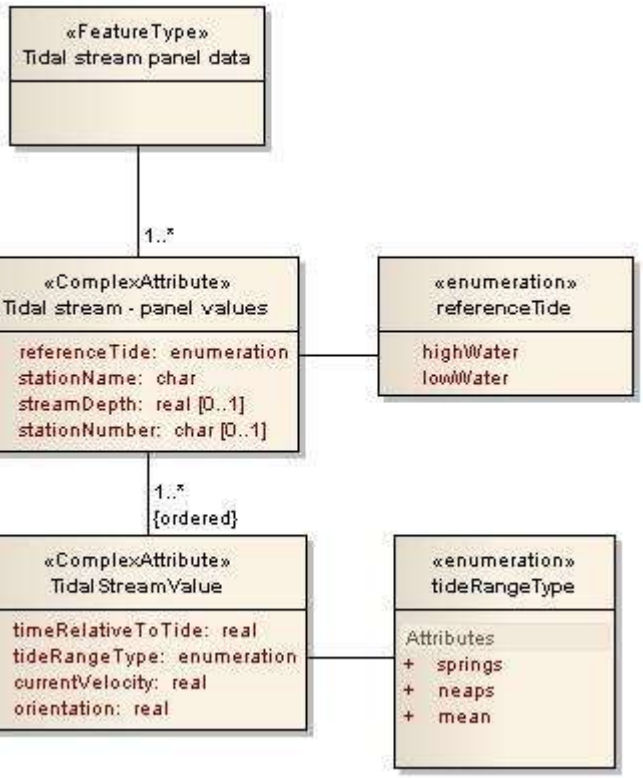
- S-100 based feature catalogues are the equivalent to an application schema. Therefore all features attributes are pre-bound to their attributes.
- The S-101 feature catalogue will contain other constraints such as feature types, geometric primitives and mandatory status of attributes.

Impact on production systems – This will make it easier to develop multi-product S-100 based systems which can accept new product feature catalogues or update existing versions.
Impact on producers – This is an important change in practical terms as it will make encoding easier, reduce training needs and reduce errors.
Impact on S-57 Converted data – None, where is not a direct mapping to S-101 validation tools will still find any errors**.**

Most of the features and attributes inherited from the S-57 ENC will remain unchanged, however the following are some examples demonstrating either improved functionality and or the end user experience.

3.1.1 Complex Attributes

These are described first because they have a significant influence on the restructuring of some of the features that will change in S-101. Complex attributes provide the ability to either replace multiple attributes or break down attributes into new sub-attributes.
For example we currently use structured text for certain attributes which consist of character strings constrained to set formats. In S-101 each element of the formatted string will be a sub-attribute. One of the more complicated formats is that of tidal stream information, the following diagram demonstrates a more logical and efficient structure.



Impact on production systems – Changes to software will be required to implement the new structure.
Impact on producers – Minimal, the actual information remains the same it will just be entered in a different way. It should also reduce the likelihood of formatting errors.
Impact on S-57 Converted data – None, there is a direct mapping to S-101**.**

3.2 Lights Features

There will be a separate feature type for the five main categories of lights – All Round, Sector, Fog Detector, Directional and Air Obstruction. This will actually simplify both the encoding and portrayal of lights. For example a light with 2 or more sectors is currently encoded as one feature per light sector. In S-101 the single light feature will have sectors encoded as complex attributes.

Impact on production systems – Changes to software will be required to implement the new structure.
Impact on producers – Minimal, in fact it will reduce the complexity of encoding sector lights and
Impact on S-57 Converted data – None, there is a direct mapping to S-101**.**

3.3 Update Feature

This has been included to enable a user to clearly see what changes have been applied by way of a notice to mariner, including any features which may have been deleted. If necessary the text of the NtM can be included with all source references and dates. One of the major benefits will be that it can be included in passage planning to detect changes which may affect a chosen route. In particular temporal changes such as to a TSS can be detected.

Impact on production systems – Changes to software will be required to implement the new feature.
Impact on producers – It is likely, but no yet confirmed, that this new feature will replace the SORIND and SORDAT attributes, however it will enable update information held in production systems to be more easily tracked. Introducing this feature will probably incur more work for encoders, but the benefit to the end user will significantly outweigh this. Over time as production systems integrate more processes the burden may actually be reduced.
Impact on S-57 Converted data – As this is a new feature it will only be available in full specification S-101 data. However there may be a possibility during the transition period to include this in the S-57 data being converted.
Impact on Users – Significant, currently the methodology for highlighting changes is at best questionable in that it is very difficult to pin point the exact change because it is mostly based on geometry. A system should now be capable of allowing queries to find any updates.

3.4 Cartographic Text Feature

This new feature and its attributes provides the means to control the positioning of text in order to reduce text clutter one the most often issues raised by users. Initially it is thought to be only appropriate for point and possibly line features, the use and limitations of this new feature will become clearer during testing.

Impact on production systems – Changes to software will be required to implement the new feature. Consideration should be given to utilizing information stored in multi-product databases.
Impact on producers – Unless, as suggested above, existing information is re-used then encoding this feature will require extra effort. However the impact on the end user will be considerable and achieving less cluttered displays should be a high priority.
Impact on S-57 Converted data – These features can only encoded in the full spec. S-101 and therefore cannot be converted.
Impact on Users – Significant, in conjunction with the use of SCAMIN it will significantly improve the user display.

3.5 Data Loading and Unloading

A new methodology based on producer defined display scales (optimal, minimum and maximum) has been introduced. This will simplify the process for ECDIS, giving clear and concise rules on how and when data is loaded and unloaded. The concept of navigation purpose has been restricted for use in presenting ENCs in a visual catalogue. The number of navigation purposes has also been reduced to three; port and approaches, coastal passage and ocean passage/routing.

Impact on production systems – Minimal, only requires the addition of two new fields.
Impact on producers – Minimal, and it may be possible to introduce an algorithm to automate the encoding of the maximum and minimum scales. This will become clearer during the test phase.
Impact on S-57 Converted data – Investigation is being undertaken to determine if the maximum and minimum scale values can be automatically generated. It may also be possible to introduce a mechanism to populate the fields during the conversion process.
Impact on Users – Significant, currently there isn't a standardized formula for loading data which has lead to inconsistent and sometimes unhelpful loading strategies being utilized.

3.6 Scale Dependant and Independent Datasets

This new concept aims to rationalise the number of updates which are required to service S-57 ENCs. It emulates the way data is usually stored in a database in that scale independent features only have one instance (e.g. a light, buoy etc.) and therefore only has to be updated once and should reduce the likelihood of error. It will also improve vertical consistency of data.It has been proved that scale independent data is the subject of more updates than scale dependant data. A scale independent dataset can cover a larger area and still be within the dataset size limit, although there

must be scale dependant datasets available which exactly cover the same area. This concept is optional for producers. The proposed move towards this new configuration of datasets will require significant testing before being considered for inclusion in the final version of S-101.

Impact on production systems – For database driven production systems introducing this should be relatively simple, although there could be some major changes in the overall system design. It has been proven that using a system based on flat file concepts is possible, however there will be a need to ensure that a capability to administrate and track the various relationships between datasets is secure and easily maintained.
Impact on producers – Once production systems are available to handle this concept then encoding overheads should be reduced. The only initial issue would be ensuring the vertical consistency of data.
Impact on S-57 Converted data – S-57 ENCs cannot be converted.
Impact on Users – More consistent data and more cost effective particularly if satellite communication for updates is involved.

3.7 Data Encoding and Classification Guide (DECG)

The DCEG is the S-101 equivalent of the S-57 Use of the Object, Feature Object and Feature Attribute Catalogues combined, and will mean that encoders have all the necessary information in one place. The DECG will undoubtedly evolve throughout the testing phases as the new features and constructs are put in to practice.

4 Impact on other Stakeholders

4.1 ECDIS OEMs

Compared to other equipment used in support of S-101 the ECDIS will require the most change. However the overall benefits will be significant in that it will overcome the current difficulties with promulgating change and improve the user's experience. Future ECDIS will not just be capable of handling S-101 data but should be thought of as S-100 enabled and capable of handling products supplementary to S-101.
The following items are some of the more major changes introduced.

4.1.1 Machine readable catalogues

Currently the intention is to provide 4 catalogues – Feature, Portrayal, Alerts and Indications and Producer Codes. The ECDIS must be capable of importing the catalogues and updating the system. In addition to the benefit of being able to deliver change more easily, there is potential to reduce type approval requirements to a one off test of the process.
This will include the capability to import feature and portrayal catalogues for other products.

4.1.2 ISO/IEC 8211

After consultation with OEMs it has been agreed that S-101 will retain the ISO/IEC8211 encoding in a modified form which conforms to S-100.

4.1.3 Least Depth Attribute

This new attribute could equally have been described in Section 3, but it will have considerably more impact in ECDIS. Currently, during the SENC build process the system has to trawl datasets to find the relationship between features such as wrecks, obstructions etc. and their underlying depth area. This relationship exists in the production systems and therefore will be populated in an attribute in the data.

4.2 Type Approval Authorities

Recent discussions on the revision and expansion of S-64 have included the opinions of type approval authorities. This work is carried through to the requirements for S-101 and will include a more test scenarios and accompanying test data. Consideration will also be given to the possibility of separating software testing from hardware where appropriate. Testing of processes will also be investigated, e.g. the process of importing test catalogues, test data and providing a default portrayal list for approval is fundamental to the concept of "plug and play".

4.3 Service Providers

One of the main issues during the transition from S-57 to S-101 ENCs will be the need for a delivery process for both types. The provision of a more robust and better structured version of S-58 will increase the efficiency of process and provide better quality control.